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CLEANUP ACTION PLAN

CENTRALIA LANDFILL

LEWIS COUNTY, WASHINGTON

SEPTEMBER 1999

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1. INTRODUCTION

This Cleanup Action Plan (CAP) has been prepared by the Washington State Department of Ecology (Ecology) to specify cleanup standards and identify the cleanup action to be implemented at the Centralia Landfill (Landfill, also referred to as the “Site”). As required by the Model Toxics Control Act (MTCA), Chapter 70.105D RCW, this CAP describes the alternatives for remediation at the Site.

2. SITE DESCRIPTION

The Centralia Landfill is a closed municipal solid waste landfill located in the City of Centralia, Lewis County, Washington, in Section 17, Township 14N, Range 2W of the Willamette Meridian (Figure 1). The unlined Landfill operated from 1958 until April 1, 1994. Originally, the Landfill encompassed property that is currently owned by the Centralia Christian School (formally owned by the Centralia Holding Corporation (CHC)) and (b) (6) [redacted] as well as the City of Centralia (Figure 1). Because refuse has been placed on all three parcels of land, this area constitutes the Site.

The City of Centralia began operating the unlined Landfill in 1958. The Closed Northend Landfill portion of the Site was filled from 1958 to 1965 using the “trench fill” method. With this method, trenches were excavated an estimated 40 feet wide by 300 feet long by 7 feet deep (i.e., below the ground surface). Waste was placed in the trenches and covered with 2 to 3 feet of soil. After completion of filling in the Closed Northend Area, the trench fill method continued in the northeast; southeast, and southwest areas of the Final Cover Area until 1978 when the operation was changed to an “area fill” method. With this method, waste was placed in lifts 3 to 8 feet thick above the ground surface, compacted, and covered with daily or intermediate cover soil 0.5 to 1 foot thick. The area fill method continued over all of the Final Cover Area until the Site stopped accepting waste on April 1, 1994. A total about 55 acres of the 87-acre site have received solid waste. The Final Cover Area encompasses about 46 acres and the Closed Northend Area consists of about 12 acres (Figure 2).

As shown in Figure 2, the Closed Northend Landfill refers to the northernmost fill area of the site. Filling in this area was completed prior to promulgation of solid waste regulations by Ecology in 1972 (Chapter 173-301 WAC). Lewis County Environmental Services determined in 1987 that this area was closed in compliance with WAC 173-301-611 for abandoned disposal sites.

When the Landfill stopped accepting waste in 1994, the Final Cover Area shown in Figure 2 received final closure with a permanent cover system consisting of a composite geomembrane and low-perrneability soil barrier layer, a drainage layer, and a vegetative soil layer. The final cover system nearly eliminates infiltration of precipitation into refuse at the Site, and directs clean surface water runoff into a wetland enhancement and mitigation area south of the Landfill. In addition to the final cover system, a permanent landfill gas collection system was installed beneath the final cover, and a permanent landfill gas flare system was installed adjacent to the Landfill entrance facilities for gas treatment (Figure 2). Perimeter fencing was completed around the Landfill to enclose all of the Final Cover Area and much of the Closed Northend Landfill. The Landfill was closed according to the requirements of the Washington State Criteria for Municipal Solid Waste Landfills (Chapter 173-351 WAC). In addition, closure of the Landfill was an interim remedial action under MTCA.

To accommodate waste disposal after closure of the Landfill, the Lewis County Central Transfer Station facility was constructed on the Closed Northend Landfill and began operation in 1994. In addition to the transfer station, the facility includes an administrative office building and a moderate risk waste facility (Figure 2). Administrative Building No. 1 and the Hazo-Hut were completed in 1996 and 1997, respectively.

During the operational history of the Site, two other structures were built on or adjacent to the Closed Northend Landfill (Figure 2). In 1977, the City of Centralia sold 5 acres of Landfill property to United Graphics, Inc. (CHC Property). On this property, a building was constructed immediately north of the waste boundary of the Closed Northend Landfill to house a check printing facility that operated until its closure in 1997. The Centralia Christian School purchased the CHC property in March 1999 and plans to open a school in the near future. In about 1980, the City sold 1-2/3 acres of the Closed Northend Landfill property to (b) (6) ((b) (6)). The (b) (6) constructed a metal-framed building on the east side of the property and began operating a petroleum equipment servicing and underground storage tank removal company.

3. PROJECT HISTORY

Several regulatory actions led to the negotiation of a consent decree with Ecology requiring completion of a Remedial Investigation/Feasibility Study (RI/FS) and a CAP for the Centralia Landfill. These actions included:

- **Preliminary Assessment**. A potential hazardous waste site preliminary assessment (PA) was conducted in October 1985 by Ecology in conjunction with the U.S. Environmental Protection Agency (EPA) to make an initial evaluation of the potential risk posed by the Site and to recommend possible additional actions.

- **Site Inspection.** EPA conducted a site inspection (SI) in 1986 because the PA screening indicated additional information was required to accurately profile the impact from landfill-derived contaminants on adjacent surface water and groundwater.

- **Preliminary Health and Resource Assessment.** The U.S. Public Health Service Agency for Toxic Substances and Disease Registry (ATSDR) visited the Landfill on March 16, 1989, and issued a preliminary health assessment in April 1990.

- **National Priorities List.** On the basis of the PA and SI, the Centralia Landfill was scored in accordance with the federal Hazard Ranking System (HRS) and was determined to be a hazardous waste site resulting in the placement of the Site on the federal National Priorities List (NPL) and the Washington State Hazardous Sites List (HSL) in August 1990. At this time, Ecology was designated the lead agency for Site cleanup.

After the Centralia Landfill was listed on the NPL and HSL, Ecology, the Centralia Landfill Closure Group (CLCG), (b) (6), and CHC entered into two consent decrees for the completion of interim actions and an RI/FS. The CLCG was formed under an interlocal agreement to oversee the remediation of the Site and is composed of the following jurisdictions: Lewis County, the City of Centralia, the City of Chehalis, the City of Morton, the City of Mossyrock, the City of Vader, and the Town of Pe Ell. In 1991, the CLCG, (b) (6), and CHC entered into a Consent Decree (C91-5 100) with Ecology to implement an interim action (hereafter termed the First Interim Action), which involved installing a temporary geomembrane cover and utilizing existing low-permeability soil cover over portions of the landfill that had achieved final grade, installing a landfill gas collection system and temporary exhauster/flare facility, installing a temporary leachate seep collection system associated with the temporary cover, upgrading surface water and erosion-control facilities, and constructing a fence around most of the Landfill property. In addition, a comprehensive leachate study was developed and conducted in 1992 and 1993 pursuant to the First Interim Action. The purpose of this study was to identify and evaluate near- and long-term leachate treatment and disposal options.

In 1994 the Landfill stopped accepting waste, and Ecology, the CLCG, (b) (6) and CHC amended the Interim Action Consent Decree to include the implementation of a permanent landfill cover system over the Final Cover Area, as an interim cleanup action at the Landfill. The final cover system was designed and construction completed by the end of 1995. The Landfill final cover system consists of a low-permeability composite cap placed over the refuse and associated engineering controls necessary to protect its integrity. These controls address:

- Surface water run-on/runoff and erosion
- Landfill gas collection and treatment
- Access restrictions

The Landfill final cover system referred to in this CAP reflects the project design as approved by Ecology in the *Centralia Landfill Second Interim Action Cover System Engineering Report* (CH2M HILL, 1994a). The Final Cover System is operated and maintained as required in Chapter 173-351 WAC. Details of the system operation and maintenance are presented in the *Centralia Landfill Final Cover System Post-Closure Operations and Maintenance Manual* (CH2M HILL, 1995)

In March 1993, the CLCG, (b) (6), and CHC entered into the RI/FS Consent Decree with Ecology (C91-5100(T)WD). The RI/FS Consent Decree specifies the process whereby the CLCG is to conduct the RI/FS and Ecology is to prepare a CAP for the Centralia Landfill. Ecology and the CLCG mutually agreed to delay work on the RI/FS to focus on completing the Landfill final cover system.

In 1994, the *Centralia Landfill Remedial Investigation/Feasibility Study/Cleanup Action Plan Draft Remedial Investigation Workplan* (Draft Workplan) (CH2M HILL, 1994b) was completed and submitted to Ecology. The Workplan includes an evaluation of the significant amount of data existing at the time. Groundwater and surface water have been routinely monitored since 1986 and 1991, respectively. Following receipt of initial comments from Ecology, the *Centralia Landfill Remedial Investigation Action Plan* (Action Plan) (CH2M HILL, 1996a) was prepared and submitted to Ecology in early 1996. The Action Plan revised the scope of work proposed in Chapter 7 of the Draft Workplan, summarized data needs, proposed field investigations for the RI to meet the data needs, and presented the overall objectives for the RI Following re iew and approval of the Action Plan by Ecology, the CLCG prepared the following RI/FS planning documents:

- *Centralia Landfill Remedial Investigation/Feasibility Study Field Sampling Plan*, (CH2M HILL, 1996b).
- *Centralia Landfill Remedial Investigation Feasibility Study Quality Assurance Project Plan* (CH2M HILL, 1996c).
- *Centralia Landfill Remedial Investigation/Feasibility Study Action-Specific Safety and Health Plan* (CH2M HILL, 1996d).

Following approval of the planning documents by Ecology, RI field investigations began in May 1996 and continued through June 1997. The field investigations included the installation of seven new groundwater monitoring wells, and sampling and analysis of groundwater, surface water, and sediment at the Site. A domestic well use survey was performed to determine the number and location of domestic supply wells within a one-mile radius of the Landfill. Five domestic wells located downgradient or cross gradient from the Landfill were sampled. The quality of groundwater from these wells does not appear to be impacted by Centralia Landfill. However, elevated levels of inorganic water quality parameters and metals are present in surface water and groundwater at the Site. Quarterly groundwater, surface water, and landfill gas monitoring are continuing at the Site in accordance with the Washington State Criteria for Municipal Solid Waste Landfills (Chapter 173-351 WAC).

The results of the RI field investigation were combined with information contained in the Draft Workplan to produce the *Centralia Landfill Remedial Investigation Report* (RI Report) (CH2M HILL, 1998a). Information from the RI Report was used to prepare the *Centralia Landfill Feasibility Study Report* (FS Report) (CH2M HILL, 1998b).

4. SURFACE WATER AND GROUNDWATER CONDITIONS

Since surface water and groundwater are the media of concern for Site cleanup, they are described below.

4.1 Surface Water Conditions

There are three perennial regional surface water features near the Centralia Landfill (Figure 3). The Chehalis River is located about 1,000 to 2,000 feet west of the Landfill and meanders in a generally south to north direction. Long-term flow rates have ranged from less than 100 cubic feet per second (cfs) to greater than 40,000 cfs. The Chehalis River is a habitat for Chinook, Coho, and Chum Salmon, and Steelhead Trout. The Landfill is in the flood plain of the Chehalis River, and flood events have inundated the Site and surrounded the refuse mound for short periods of time. Salzer Creek, a tributary of the Chehalis River, flows from east to west, passes through the southeastern corner of the Site, and then continues just south of the Site property boundary for about 2,000 to 3,000 feet before reaching its confluence with the Chehalis River. Salzer Creek contains a seasonal run of Coho salmon. Coal Creek flows into Salzer Creek approximately 1,700 feet upstream of the, Site's southeast property boundary.

Onsite surface water features include Weyerhaeuser Ditch, the Closed Northend Landfill stormwater controls, and the Final Cover Area stormwater control system (Figure 4). Weyerhaeuser Ditch originates from a culvert upgradient of the Landfill, near the northwest corner of the CHC Property, and continues south along the western perimeter of the Site for about one-mile until it discharges into Salzer Creek. Flows from the Closed Northend Landfill stormwater controls into Weyerhaeuser Ditch include some overland stormwater runoff from the CHC and (b) (6) [redacted], stormwater inflow from the Closed Northend Landfill, discharge from an apparent oil-water separator on the (b) (6) [redacted], and discharge from culverts from the west side of the Lewis County Transfer Station. Other Closed Northend Landfill stormwater flows include overland stormwater runoff from the east side of the CHC Property into the City of Centralia stormwater system, and stormwater from the east side of the Lewis County transfer Station that flows into the wetland area located along the east side of the Landfill. The Final Cover Area stormwater control system consists of runoff control berms, ditches, and culverts that discharge into the Southeast and Southwest Level Spreaders. The level spreaders disperse stormwater into the South Wetland Area to enhance wetland quality and reduce peak runoff flows into Weyerhaeuser Ditch.

Flow in Weyerhaeuser Ditch occurs only during the wet season, generally from November through May. Flow rates in Weyerhaeuser Ditch vary with the amount of precipitation. Although Weyerhaeuser Ditch receives some flow from shallow groundwater during the wet season (see Section 4.2), any seasonally sustained flow rates are very low. As discussed above, the Landfill is in the flood plain of the Chehalis River. During certain flood events, flood waters from Salzer Creek may flow up Weyerhaeuser Ditch and surround the refuse mound for short periods of time.

4.2 Groundwater Conditions

The Centralia Landfill vicinity is underlain by 60 to 70 feet of unconsolidated Quaternary sediments. These sediments include surficial silt and clay deposited in existing marsh areas, silty fine to medium sand and silt deposited as river bed and flood plain alluvium by the Chehalis River, and sand and gravel deposited as advance glacial outwash. These sediments rest uncomformably on Tertiary siltstone/sandstone bedrock of the Skookumchuck Formation and comprise the hydrogeologic Units beneath the site

Groundwater monitoring well locations are shown in Figure 5. Figure 6 shows southwest-northeast geologic cross section D-D' from the RI Report. Figure 7 shows south-north geologic cross section F-F' also from the RI Report. The locations of these cross sections are shown in Figure 5. These cross sections show the relative locations and thickness of the sediments beneath the Site. These sediments have been divided into two water-bearing units: the Shallow Upper/Upper Unit and the Lower Unit. Each of these units is described below.

Shallow Upper/Upper Unit. This water-bearing unit consists of a surficial layer of green-brown silt to clayey silt which varies in thickness from about 6 feet in the area of monitoring well MW-ID to about 16 feet in the vicinity of monitoring well B-3S. Where it is not covered by structures or artificial fill, this layer crops out at the surface in existing grassland or marsh (e.g., the South Wetland Area). Beneath this silt bed are interbedded layers of light, brown to dark gray.fine to medium silt sand and sand. Some of these sand layers appear to be continuous across the site and range in thickness from about 4 feet in the area of monitoring well B-3S to about 44 feet in the area of monitoring well MW-ID. Based on boring logs, these sand layers appear to be in direct contact with portions of the bottom of the Landfill and may be a preferential flow path for leachate (Figures 6 and 7). Beneath these sand layers are beds of dark gay to green gay silt, clayey silt, and sandy silt. These silt beds vary in thickness from less than 5 feet in the vicinity of monitoring well MW-3S to about 30 feet at former monitoring well B-7D (abandoned). The total thickness of the Shallow Upper/Upper Unit is about 44 to 65 feet below ground surface (bgs).

The depth to groundwater in the Shallow Upper/Upper Unit ranges from about 2 to 7 feet bgs during the wet season to about 5 to 11 feet bgs during the dry season. Groundwater flows from the northeast to the southwest towards Salzer Creek and the Chehalis River (Figure 8). Water table gradients in the Shallow Upper/Upper Unit have ranged from 1.9×10^{-3} to 3.3×10^{-3} . The hydraulic conductivity of the Shallow Upper/Upper Unit is estimated to range from about 8.5×10^{-5} cm/s to 1.6×10^{-3} cm/s with an estimated flow velocity ranging from 3.3×10^{-2} feet per day to 4.4×10^{-2} feet per day.

This water-bearing unit is designated the Shallow Upper/Upper Unit because some monitoring wells downgradient of the Final Cover Area are completed in the shallow portion of the Upper Unit and some at deeper depths in the Upper Unit (Figure 6). Monitoring wells B-1SU, B-2SU, MW-4S, MW-5S, and MW-2SU are all completed in the shallow portion of this water-bearing unit (10-foot screened intervals range from 6.5 to 18 feet bgs). Monitoring wells B-1S, B-2S, B-3S, and MW-2S are completed in deeper portions of this unit (10-foot screened intervals range from 17 to 30 feet bgs). In the area of the B-1S and B-2S monitoring well clusters a lense of silt and sandy silt about 12 feet thick occurs within the sand layers described above (Figure 6). Monitoring wells B-1S and B-2S are completed in this silt layer. Monitoring well B-3S is also screened in silt material just below the 4-foot thick sand layer at this location (Figure 7). Monitoring well MW-2S is screened from 18 to 28 feet bgs in sand and silty sand.

In most cases, vertical hydraulic gradients between monitoring wells completed in the shallow and deeper portions of the Shallow Upper/Upper Unit were near zero (i.e., water level differences were less than 0. 1 foot). However, 1997 water levels indicated that positive gradients of 1.3×10^{-2} and 1.7×10^{-2} were present between monitoring wells MW-2S and MW-2SU on the west side of the Landfill, and negative gradients of 3.0×10^{-2} and 6.0×10^{-2} were present between monitoring wells B-1S and B-1SU at the southwest comer of the Landfill. These data suggest that the vertical component of groundwater flow in the Shallow Upper/Upper Unit at the time of these measurements was upwards towards Weyerhaeuser Ditch at MW-2S and MW-2SU and downwards towards Salzer Creek or Weyerhaeuser Ditch at B-1S and B-1SU.

Lower Unit. This unit consists of advance glacial outwash sand and gravel and is part of the Centralia-Chehalis Lowland Regional Aquifer. This section of light to dark gray fine to coarse sand with fine to coarse gravel, and sandy fine to coarse gravel varies in thickness from about 6 feet in the vicinity of MW-1D to about 22 feet in the area of MW-2D. Based on cross section interpretation, this section appears to thin to the northeast and thicken to the northwest. Groundwater in the Lower Unit flows from the northeast to the southwest toward Salzer Creek and the Chehalis River (Figure 9). Potentiometric surface gradients have ranged from 1.4×10^{-3} to 2.5×10^{-3}. The hydraulic conductivity of the Lower Unit is estimated to range from 2.2×10^{-2} cm/s to 2.3×10^{-1} cm/s with an estimated flow velocity ranging from 3.6 to 4.9 feet per day. The domestic well use survey performed identified 60 private wells screened in the Lower Unit located within 1 mile of the Site and 8 City of Centralia water supply wells located over a mile northwest and north of the Site. Three private wells were located downgradient within 1 mile of the Site.

As shown in Figures 6 and 7, there are no impermeable or impervious layers separating the Shallow Upper/Upper Unit from the Lower Unit, other than the silt and sandy silt layers beneath the Site. To estimate downward flow rates, vertical hydraulic gradients were measured between the Shallow Upper/Upper Unit and the Lower Unit. In most cases, the vertical gradients were negative (indicating downward flow), and the negative vertical gradients ranged from 1.0×10^{-2} to 9.0×10^{-2}.

Figure 7 also shows water levels. measured in piezometers completed within the landfill in June and September, 1996. Water levels in the landfill indicate that groundwater mounding is occurring within the refuse and that leachate is generated by groundwater flowing through the refuse. The RI Report estimated that 70,000 gallons of leachate are generated annually as a result of groundwater flow through older refuse beneath the Final Cover Area. However, this quantity of leachate is only about two percent of the total quantity of leachate that had been generated by precipitation and groundwater flow-through prior to the installation of the final cover system.

5. NATURE AND EXTENT OF CONTAMINATION

Investigations performed at the Centralia Landfill indicate that surface water and groundwater are the only media affected by the release of hazardous substances from the Landfill. Leaching is probably the primary contaminant release mechanism for hazardous substances from the Landfill. Leachate is a product of naturat biodegradation, precipitation infiltration, and groundwater migration through landfilled refuse. The infiltration of precipitation through refuse was the major source of leachate production. The RI Report estimated the infiltration of precipitation through refuse to be 98% of leachate production. However historical information on landfill construction and water level data from the RI indicate that some groundwater is flowing through the waste and that there is some mounding of groundwater within the refuse beneath the Final Cover Area (Figure 7).

Shallow Upper/Upper Unit groundwater has been affected by the Landfill. Surface water quality in Weyerhaeuser Ditch has been impacted by the flow of Shallow Upper/Upper Unit groundwater into the ditch adjacent to the Final Cover Area. Significant impacts on Lower Unit groundwater have not been verified because there are similar concentrations of contaminants in Lower Unit groundwater both upiradient and downgradient of the Landfill. By nearly eliminating the infiltration of precipitation through refuse, the final Landfill cover system will greatly reduce the quantity of leachate generated. Therefore, the Landfill cover system is expected to reduce contaminant concentrations in Shallow Upper/Upper Unit groundwater and in surface water in Weyerhaeuser Ditch as well as reduce the potential for the contamination of Lower Unit groundwater.

5.1 Surface Water

Surface water monitoring in Salzer Creek upstream and downstream of the Landfill did not reveal impacts to Salzer Creek from the Landfill. The results of surface water monitoring in Weyerhaeuser Ditch indicate elevated levels of total and soluble arsenic, total and soluble iron, and total and soluble manganese downgradient of the Landfill. Based on an analysis of the most stringent applicable or relevant and appropriate requirements (ARARs), potential risks to human health were identified only for arsenic. Arsenic poses a threat to human health through consumption of surface water and organisms. The applicable ARAR for arsenic is the Federal Human Health Criteria for Consumption of Water and Organisms (40 CFR 131.36(b)(1)). Arsenic concentrations exceed the 0.0 18 parts per billion (ppb) ARAR in all samples, with concentrations downgradient of the Landfill slightly higher than background levels found in Weyerhaeuser Ditch. There are no surface water ARARs for iron or manganese. Total mercury was detected only once during the RI but is a concern because it has been sporadically detected during historical surface water sampling and testing. Potential risks to aquatic organisms were identified for total mercury. The average and range of concentrations detected during the RI at Weyerhaeuser Ditch monitoring stations are presented in Table 1.

Historical Weyerhaeuser Ditch surface water monitoring data show that concentrations of total cadmium, total copper, total lead, total silver, and total zinc were elevated in the past. However, the ARARs for these metals apply to the soluble form of the metal. Analyses for soluble metals were performed on a limited basis during the historical monitoring period. During the RI both soluble and total metals analyses were performed. Soluble metals concentrations have exceeded ARARs on only rare occasions. However, continued monitoring is needed to ensure that these metals are not present in concentrations that are an environmental concern.

5.2 Shallow Upper/Upper Unit Groundwater

The results of groundwater monitoring in the Shallow Upper/Upper Unit indicate elevated levels of conductivity, chloride, and soluble arsenic, iron, and manganese downgradient of the Landfill. Of these contaminants, arsenic and manganese were identified as potential risks to human health from the consumption of groundwater. An analysis of risks associated with groundwater flow into surface water indicate that arsenic also poses potential risks to human health in surface water through the consumption of water and organisms. Soluble arsenic is present in upgradient Shallow Upper/Upper Unit groundwater monitoring wells, but at lower concentrations than those detected downgradient of the Landfill.

Historically, mercury has been inconsistently detected in Shallow Upper/Upper Unit groundwater monitoring wells. During the RI, four rounds of groundwater monitoring were performed. No mercury was detected in any Shallow Upper/Upper Unit monitoring wells during round 1and round 2 of monitoring. However during round 3, mercury was detected in eight monitoring wells (including all 3 upgradient wells) at concentrations at or just above the method detection limit of 0.1 ppb. During round 4, mercury was detected only in one well at a concentration of 0.11 ppb. It is possible that mercury is present in upgradient Shallow Upper/Upper Unit groundwater, but additional monitoring at lower detection limits is needed to verify an upgradient source and to better quantify mercury concentrations in Shallow Upper/Upper Unit groundwater. Mercury poses potential risks to human health from the consumption of groundwater, and in surface water through consumption of organisms.

Soluble Antimony was detected above the 6 ppb drinking water standard only in monitoring well MW-CNE1S. However, only newly installed monitoring wells were analyzed for antimony during the RI because antimony was not detected in pre-RI wells during historical monitoring. However, antimony detection limits for some historical and RI analyses exceed the 6 ppb drinking water standard. Therefore, additional monitoring for soluble antimony in all wells, and at a lower detection limit is needed to evaluate soluble antimony in Shallow Upper/Upper Unit groundwater. The average and range of contaminant concentrations detected during the RI at monitoring wells screened in the Shallow Upper/Upper Unit are presented in Table 2.

Historical data from downgradient Shallow Upper/Upper Unit monitoring wells indicate that concentrations of soluble cadmium, lead, silver, and zinc were elevated in the past. However, more recent monitoring during the RI show that concentrations of these metals have decreased. Continued monitoring will ensure that concentrations of these metals are not a threat to human health and the environment. On the basis of the RI source characterization and results of analyses, the Landfill is a source of the contaminants found in Shallow Upper/Upper Unit groundwater, and flow of this groundwater into Weyerhaeuser Ditch is probably the source of the contaminants identified in surface water in Weyerhaeuser Ditch

5.3 Lower Unit Groundwater

The results of groundwater monitoring in the Lower Unit identified elevated levels of soluble arsenic, manganese; and iron in upgadient and downgradient monitoring wells. As shown in Table 3, the range of concentrations for these contaminants is similar for upgradient and downgradient monitoring wells. During the third round of RI groundwater monitoring, mercury was detected at or just above the 0.1 ppb method detection limit in four of the five Lower Unit monitoring wells (including the upgradient monitoring well). Additional monitoring at lower detection limits is needed to evaluate the presence of mercury in the Lower Unit.

Five private supply wells identified during the domestic well use survey were sampled and analyzed during the RI. Total metals concentrations in these supply wells near the Site (two located downgradient, and three crossgradient of the Landfill) were compared to maximum contaminant levels (MCLs) for drinking water. Total iron exceeded the 300 ppb secondary MCL in all of the water supply wells during each RI monitoring round, and total manganese exceeded the 50 ppb secondary MCL in all but one of the water supply wells during each RI monitoring round. Total cadmium exceeded the 5 ppb MCL in one well during one monitoring round, but was undetected during the other three rounds of RI monitoring. In addition to the five private supply wells sampled, six additional private supply wells located upgradient of the landfill were sampled and analyzed for total and soluble arsenic. Arsenic concentrations, in all monitoring and supply wells exceed the 0.06 ppb MTCA Method B cleanup level. The range of concentrations of soluble arsenic and manganese is similar in both the supply wells and Lower Unit monitoring wells (Table 3). However, there appears to be higher soluble iron concentrations in the water supply wells than in Lower Unit monitoring wells. Of the contaminants identified in Lower Unit groundwater, arsenic and manganese were identified as potential risks to human health. The average and range of contaminant concentrations detected during the RI from monitoring wells and water supply wells screened in the Lower Unit are presented in Table 3.

During the third round of RI groundwater monitoring, mercury was detected at or just above the 0.1 ppb method detection limit in two supply wells, both located crossgradient of the Landfill. As discussed above, additional monitoring at lower detection limits is needed to determine if mercury is actually present in groundwater. Mercury concentrations detected in Lower Unit monitoring and supply wells are well below the 2 ppb primary MCL, which is the applicable ARAR for Lower Unit groundwater.

6. CLEANUP STANDARDS

As outlined in MTCA (WAC 173-340-700(2)(a)), establishing cleanup standards for individual sites requires the specification of cleanup levels, point(s) of compliance, and additional regulatory requirements that apply to a particular cleanup action. Cleanup levels for surface water and groundwater were established using MTCA Method B (WAC 173-340-705) which references ARARs based on applicable state and federal laws in addition to providing methods, for calculating cleanup levels on the basis of toxicity or carcinogenic risk.

6.1 Surface Water Cleanup Levels and Point of Compliance

Method B cleanup levels for surface water were established as outlined in WAC 173-340-730(3). Initially a cleanup level was established for arsenic using the most stringent applicable federal and state laws. This process resulted in an arsenic cleanup level of 0.018 ppb based on the Federal Human Health Criteria for Consumption of Water and Organisms (40 CFR 131.36(b)(1)). However, since Shallow Upper/`Upper Unit groundwater flows into Weyerhaeuser Ditch, background arsenic concentrations in upgradient monitoring wells must be considered (WAC 173-340-700(4)(d)). Data from upgradient Shallow Upper/Upper Unit monitoring wells MW-1S, MW-3S, and M-4 were used to calculate a background arsenic concentration as outlined in WAC 173-340-708(l1). The natural background arsenic concentration of 0.27 ppb was calculated according to the *Washington State Department of Ecology Guidance on Sampling and Data Analysis Methods*. As per the MTCA (WAC 173-340-700(4)(d)), the cleanup level is established at a concentration equal to the natural background concentration. Therefore the surface water cleanup level for arsenic is 0.27 ppb. However, 0.27 ppb is less than the practical quantitation limit (PQL). The PQL is the lowest concentration that can be reliably measured within specified limits of precision, accuracy, representiveness, completeness, and comparability during routine laboratory operating conditions, using Ecology approved methods. In these cases when the cleanup level is less than the PQL, the cleanup level may be considered to be attained if the parameter is undetected at the PQL, and the conditions outlined in WAC 173-340-707 are met to Ecology's satisfaction. The current PQL for arsenic is 0.5 ppb, and is defined as the compliance level for arsenic in surface water. Since there are no surface water ARARs for iron or manganese, surface water cleanup levels are not needed for these parameters.

MTCA requires that the point of compliance for surface water be the point at which hazardous substances are released to surface waters of the state (WAC 173-340-730 (6)). Eco logy has previously determined that Weyerhaeuser Ditch is not a water of the state. For the Centralia Landfill, the point of compliance for surface water will be at monitoring station SW-14, which is located in Weyerhaeuser Ditch at the southwest comer of the Site (see Figure 4). This location is at a pointjust before flows in Weyerhaeuser Ditch pass the Site property boundary and discharge into Salzer Creek. The average arsenic concentration at SW-14 is 1.4 ppb. The surface water leanup standard for arsenic is expected to be achieved within a reasonable period of time through natural attenuation.

6.2 Groundwater Cleanup Levels and Point of Compliance

Under WAC 173-340-720(l)(a), cleanup levels for groundwater are established on the basis of the highest beneficial use of the affected groundwater and the reasonable maximum exposure expected to occur under both current and potential future Site use conditions. The highest beneficial Use of groundwater from both the Shallow Upper/Upper Unit and the Lower Unit is for drinking water. Therefore, cleanup levels are established based on exposure to hazardous substances via ingestion of drinking water, which represents the reasonable maximum exposure at the Site. In addition, contaminant concentration's in the Shallow Upper/Upper Unit must also protect nearby surface water because Shallow Upper/Upper Unit groundwater discharges to Weyerhaeuser Ditch and Salzer Creek. Cleanup levels for contaminants in the Shallow Upper/Upper Unit are established using MTCA Method B for groundwater and surface water (WAC 173-340-720(3) and WAC 173- 340-730(3)). Cleanup levels for contaminants in the Lower Unit are established using MTCA Method B for groundwater (WAC 173-340-720(3)). Cleanup levels for the Shallow Upper/Upper Unit and for the Lower Unit are discussed below followed by a discussion of the point of compliance for both units.

Shallow Upper/Upper Unit Cleanup Levels. Table 4 presents cleanup and compliance levels for the Shallow Upper/Upper Unit. Since this unit discharges into surface water near the Site, surface water and groundwater ARARs were used to establish cleanup levels. Based on these ARARs and contaminant concentrations detected, cleanup levels are needed for conductivity, chloride, arsenic, iron, and manganese. Surface water ARARs were more stringent than groundwater ARARs for arsenic and were used to establish the cleanup level for arsenic. As discussed above in section 6.1, the arsenic cleanup level is 0.27 ppb, based on background arsenic concentrations in upgradient Shallow Upper/Upper Unit monitoring wells. However, 0.27 ppb is less than the PQL. In these cases, the cleanup level may be considered to be attained if the parameter is undetected at the PQL, and the conditions outlined in WAC 173-340-707 are met to Ecology's satisfaction. The-current PQL for arsenic is 0.5 ppb, and is defined as the compliance level for arsenic in Shallow Upper/Upper

Unit groundwater. Groundwater ARARs are the most stringent ARARs for the other contaminants.. Cleanup levels for conductivity, chloride, manganese, and iron are established based on federal and state secondary maximum contaminant levels (MCLs) for drinking water, which are the most stringent groundwater ARARs for these parameters. Secondary MCLs were created based on aesthetic qualities such as taste and color and are not considered risk-based cleanup levels. There are no risk-based cleanup levels for conductivity, chloride, or soluble iron. The MTCA Method B cleanup level (calculated based on toxicity) for soluble manganese is 2,240 ppb, which is less stringent than the 50 ppb secondary MCL.

As discussed above in Section 5.2, RI and historical groundwater monitoring suggest that there may be background concentrations of soluble mercury in the Shallow Upper/Upper Unit. Surface water ARARs are the most stringent ARARs for mercury. The cleanup level for mercury would be 0.012 ppb based on the Federal Freshwater Chronic Criteria (40 CFR 131.36(b)(1)) and the State Freshwater Chronic Criteria (WAC 173-201A-040(3)). However, the current PQL for mercury is 0.3 ppb, and would be the compliance level (see Section 6.1). As shown in Table 2, the highest mercury concentration detected in the Shallow Upper/Upper Unit is 0.3 ppb. All other mercury concentrations detected during the RI are less than 0.2 ppb. Future monitoring of the Shallow Upper/Upper Unit will provide enough data to determine if mercury is actually present in groundwater, and if there is an upgradient source. These data will be used to evaluate the need for mercury cleanup levels.

Lower Unit Cleanup Levels. Since this unit does not discharge to surface water near the Site, only groundwater ARARs were used to establish cleanup levels. Although concentrations of arsenic, iron, and manganese are elevated upgradient and downgradient of the Landfill, cleanup levels are needed for these parameters. At this time, the appropriate data are not available to evaluate the applicability of site-specific background based cleanup levels. Therefore, the applicable cleanup level for arsenic is the 5 ppb MTCA Method A cleanup level, which is based on background concentrations for the state of Washington. Cleanup levels for manganese and iron are established based on federal and state secondary MCLs for drinking water. Cleanup levels for the Lower Unit are presented in Table 4.

Since there is only one background monitoring well in the Lower Unit, continued and expanded background monitoring is needed to determine if background contaminant concentrations are higher than the cleanup levels established for the Lower Unit. If background concentrations of arsenic, iron, and/or manganese are higher than cleanup levels, background based alternative cleanup levels will be established in accordance with MTCA guidance (Ecology, 1992 and 1993). If needed, alternative cleanup levels will be established at the first Ecology periodic review (WAC 173-340-420). The Ecology periodic review process is discussed in Section 8 of this document.

Groundwater Point of Compliance. The point of compliance for groundwater cleanup at the Centralia Landfill will be the existing property boundary (Figure 2). The final Landfill cover system and associated surface water controls are anticipated to minimize further production and migration of leachate contaminated groundwater. Groundwater cleanup standards are anticipated to be achieved within a reasonable period of time through natural attenuation.

7. SUMMARY OF REMEDIAL ACTION ALTERNATIVES

As discussed previously in this document, capping the Landfill was an interim remedial action under MTCA. Three additional remedial action alternatives were developed and evaluated for the Centralia Landfill:

- **Alternative 1.** Closure and post-closure care requirements of Chapter 173-351 WAC, including continued implementation of the Ecology approved operation and maintenance (O&M) manual.
- **Alternative 2.** Closure and post-closure care requirements of Chapter 173-351 WAC, including continued implementation of the Ecology approved O&M manual, plus institutional controls and compliance monitoring for surface water and both groundwater Units.
- **Alternative 3.** Closure and post-closure care requirements of Chapter 173-351 WAC, including continued implementation of the Ecology approved O&M manual, institutional controls and compliance monitoring for surface water and both groundwater units; collection, containment, treatment, and disposal for Shallow Upper/Upper Unit groundwater.

Alternative 1. The closed Landfill would continue to be managed as required by the Washington State Criteria for Municipal Solid Waste Landfills (Chapter 173-351 WAC) and the Ecology approved O&M manual. Post-closure activities include continued operation and maintenance (O&M) of the landfill gas control system, maintenance of the final cover and surface water control systems, and monitoring of groundwater and surface water. In addition, the wetlands mitigation plan, which is ongoing in the South Wetland Area, would continue to be implemented.

Alternative 2. Alternative 2 provides for institutional controls and compliance monitoring, in addition to the activities outlined in Alternative 1. Institutional controls would include establishment of Ecology-approved restrictive deed covenants to protect the final cover system and associated engineering controls. Monitoring would include the preparation and implementation of an Ecology-approved compliance monitoring plan that meets MTCA requirements and includes supplemental background groundwater monitoring.

Alternative 3. Alternative 3 encompasses Alternatives 1 and 2 and adds collection, containment, treatment, and disposal of Shallow Upper/Upper Unit groundwater. Collection and containment would involve the construction of a perimeter collector (French drain) along the west and south sides of the Landfill with a pump station in the northwest corner of the Landfill. Treatment and disposal would involve equalization followed by evaporation and brine crystallization with effluent discharge to Salzer Creek.

Alternative 3 would also address impacts to surface water in Weyerhaeuser Ditch from flow of Shallow Upper/Upper Unit groundwater into the ditch because groundwater would be captured before reaching the ditch. Therefore, it was not necessary to consider collecting and treating surface water in Weyerhaeuser Ditch as a separate remedial action alternative. In addition, collecting and treating surface water in Weyerhaeuser Ditch is an impracticable remedial action alternative. The seasonal, variable, and overall low flow rates in

Weyerhaeuser Ditch and the potential for Site flooding prevent a collection and treatment system from being designed, constructed and implemented in a reliable and effective manner.

8. PROPOSED REMEDIAL ACTION ALTERNATIVE

In addition to capping the Landfill, Alternative 2 was selected as the preferred remedial action alternative for the Site. Factors considered in the selection of Alternative 2 were:

- Additional time is needed to evaluate the impacts of the final cover system on Shallow Upper/Upper Unit groundwater.
- There is little risk of exposure to contaminants from the Site.
- It is not clear that Alternative 3 would provide significant benefits to downgradient groundwater or to surface water in Salzer Creek within a shorter time frame than would Alternative 2.
- The costs for Alternative 3 are substantial and disproportionate based on the overall benefit when compared to the costs for Alternative 2.
- Periodic review under MTCA will provide for ongoing site evaluations and, if necessary, for the implementation of additional cleanup actions.

Given the low groundwater flow velocities (3.3 to 4.4 x 10^{-2} feet per day) estimated during the RI for the Shallow Upper/Upper Unit, it could take several years for the effects of the final cover system to become evident in downgradient monitoring wells. Since the RI was conducted only 3 years after installation of the final cover system was substantially complete in September 1994, it is reasonable to allow additional time to monitor changes in contaminant concentrations in response to the construction of the final cover system.

In view of the fact that adjacent downgradient property is used for the land application of food processing wastewater and is located in the Chehalis River floodway, and that no water supply wells can be installed within 1,000 feet of the Landfill property boundary (WAC 173-160-171(3)(c)), there is a very low current and future risk of exposure to contaminants in groundwater. In addition, it is unlikely that any new wells would be installed in the Shallow Upper/Upper Unit because of it’s lower yield relative to the Lower Unit.

Although Alternative 3 would reduce concentrations of contaminants in Weyerhaeuser Ditch, these reductions would not likely result in improvements to water quality in Salzer Creek. RI surface water monitoring results do not indicate any impact on Salzer Creek water quality from contaminants in Weyerhaeuser Ditch.

While Alternative 3 would provide additional control over migration of contaminants from the Landfill, downgradient concentrations of contaminants that react with the groundwater matrix would tend to remain at elevated concentrations for an extended time. Therefore, Alternative 3 would not provide significant improvements to downgradient groundwater quality within a short time frame. Similar improvements in downgradient groundwater could result from implementation of Alternative 2 or Alternative 3 within a longer time frame.

Construction of Alternative 3 would result in short-term impacts to adjacent wetlands and to surface water in Weyerhaeuser Ditch.

The increased costs for Alternative 3 (approximately $14.3 million) would be substantial and disproportionate based on the overall benefit when compared to the costs for Alternative 2. The potential increased short-term benefits to surface water quality in Weyerhaeuser Ditch associated with Alternative 3 are outweighed by the potential for similar long-term benefits to groundwater and surface water quality, the ease of implementation, the absence of short-term adverse impacts, and the low cost of Alternative 2. Based on these considerations, Ecology has determined that it is not practicable to treat Shallow Upper/Upper Unit groundwater.

WAC 173-340-420 provides for the periodic review by Ecology of sites with cleanup actions that result in hazardous substances remaining at the site at concentrations that exceed Method A or Method B cleanup levels. This review will occur at least every 5 years and will include an evaluation of:

- The effectiveness of ongoing or completed cleanup actions
- New scientific information for individual hazardous substances or mixtures present at the Site
- New ARARs for hazardous substances present at the Site
- Current and projected Site uses
- The availability and practicability of MTCA’s higher-preference technologies
- The availability of improved analytical techniques to evaluate compliance with cleanup levels. If improved analytical methods result in lower PQLs, then the compliance levels listed in Table 4 will be adjusted down to the lower PQL.
- The Ecology approved O&M Manual, Compliance Monitoring Plan, and Wetlands Mitigation Plan to determine if updates are needed.

Ecology will publish a notice of the review in the site register and will allow an opportunity for public comment. If Ecology determines that substantial changes in the cleanup action are necessary to protect human health and the environment at the Site, Ecology will prepare a revised draft Cleanup Action Plan, provide opportunity for public comment, issue the final revised Cleanup Action Plan, and implement additional cleanup actions.

9. SELECTION OF CLEANUP ACTION

MTCA specifies the criteria for selecting an appropriate cleanup action. Presented below are the requirements for selecting a cleanup action along with determinations of how the selected cleanup action meets each requirement.

9.1 Protection of Human Health and the Environment

The selected alternative will protect human health and the environment by minimizing further production and migration of leachate into Shallow Upper/Upper Unit groundwater and surface water, and by minimizing the potential for the vertical migration of leachate into Lower Unit groundwater.

9.2 Compliance with Cleanup Standards

The selected cleanup action will continue to minimize the volume of leachate generated. Cleanup standards will be achieved in surface water and both groundwater Units by natural attenuation in a reasonable period of time. Compliance with cleanup levels or alternative cleanup levels will be evaluated using data collected since substantial completion of the final cover system (September 1994).

To ensure that human health and the environment are being protected, the cleanup action will be reviewed at least every 5 years by Ecology in accordance with WAC 173-340-420, and Section XXIII of the Consent Decree.

9.3 Compliance with ARARs

The following ARARs apply to the Site:

State Laws and Regulations

a. State environmental Policy Act (Chapter 197-11 WAC)

b. Minimum Standards for Construction and Maintenance of Water Wells (Chapter 173-160 WAC)

c. Water Pollution Control (Chapter 90.48 RCW)

d. NPDES Permit Program (Chapter 173-220 WAC)

e. Water Quality Standards for Surface Waters of the State of Washington (Chapter 173-201WAC)

f. Criteria for Municipal Solid Waste Landfills (Chapter 173-351 WAC)

g. Dangerous Waste Regulations (Chapter 173-303 WAC)

h. Washington Clean Air Act (Chapter 70.94 RCW)

i. Washington Industrial Safety and Health Act (WISHA) (WAC 296-62-300)

Federal Laws and Regulations

j. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (40 CFR 300)

k. Resource Conservation and Recovery Act (RCRA) (40 CFR 261 and 264)

l. Occupational Safety and Health Act (OSHA) (29 CFR subpart 1910.120)

m. Federal Water Pollution Control Act of 1972 (Clean Water Act) (40 CFR 122, 131, and 132)

n. Water Quality Act of 1987:

1) Section 308. Establishes water quality criteria for toxic pollutants.

2) Section 402. Establishes the NPDES permit process for discharges to surface water bodies.

o. Safe Drinking Water Act of 1974 (40 CFR 141 and 143)

The above list of ARARs does not preclude subsequent identification of applicable state and federal laws (WAC 173-340-360 (10)(a)(vii)). The selected cleanup action is capable of complying with the above ARARs.

9.4 Compliance Monitoring

Compliance monitoring requirements are specified in WAC 173-340-410. The following compliance monitoring will be included as part of the selected cleanup action.

- Protection monitoring will be provided to ensure protection of human health and the environment during the period of O&M of the Landfill final cover system.
- Performance monitoring will be provided to confirm that the final cover system has achieved cleanup standards and met the performance criteria. Performance monitoring data collected since substantial completion of the final cover system (September 1994) will be used to determine if cleanup levels have been achieved.
- Confirmational monitoring will be provided to confirm the long-ter m effectiveness of the final cover system after cleanup standards and the performance criteria have been achieved.
- Supplemental background groundwater monitoring will be conducted to determine if alternative cleanup levels are needed for contaminants that are present in upgradient groundwater at the Site.

A compliance monitoring plan will be prepared and submitted to Ecology for review and approval.

9.5 Long-Term Effectiveness

The selected remedial action will remain effective in the long term provided that continuous monitoring and operation and maintenance occur. Monitoring will be addressed by implementing the compliance monitoring plan. Maintenance will be addressed by continuing to implement the requirements of the *Final Cover System Post-Closure Operation and Maintenance Manual* (CH2M HILL, 1995), and protection of the final cover system and associated engineering controls will be addressed by establishing restrictive deed covenants for the Site.

9.6 Short-Term Effectiveness

Human health and the environment were protected during construction of the final cover system and were addressed in the *Centralia Landfill Second Interim Action Cover System Engineering Report* (CH2M HILL, 1994a). There will be no short-term impacts to human health or the environment during implementation of this alternative. There will be a low degree of risk to human health and the environment prior to attainment of cleanup standards.

9.7 Permanent Reduction in the Toxicity, Mobility, and Volume of Hazardous Substances

Since it is not feasible to remove the contents of the landfill, there is no way to reduce the toxicity or volume of hazardous substances within the landfill. The mobility of hazardous substances has been reduced through the installation of the final cover system. The final cover system will minimize the vertical and lateral migration of leachate contaminated groundwater by reducing the quantity of leachate generated.

9.8 Ability to be Implemented

Many elements of the selected cleanup alternative have been implemented. The Landfill has been closed, the final cover system and associated engineering controls are complete, and the required post-closure requirements are being implemented. Groundwater and surface water monitoring required in the Ecology approved compliance monitoring plan will replace the current groundwater and surface water monitoring being performed. The restrictive deed covenant is presented as Exhibit F in the Consent Decree.

9.9 Cleanup Costs

There will be some costs associated with the preparation of the compliance monitoring plan (less than $150,000). Costs for additional monitoring are estimated to be less than a 10 percent increase over current monitoring costs.

As required under WAC 173-351-500, post-closure maintenance and monitoring activities will continue for at least a 30-year period or until Ecology finds that post-closure monitoring has established that the facility is stabilized (i.e., little or no settlement, gas production, or leachate generation). In addition, WAC 173-340-360(8)(b) requires long-term monitoring and institutional controls to continue until residual hazardous substance concentrations no longer exceed Site cleanup levels.

9.10 Addresses Community Concerns

To be addressed as part of the public review process for this Draft CAP.

REFERENCES

CH2M HILL. *Centralia Landfill Second Interim Action Cover System Engineering Report.* Two Volumes. Prepared for the Centralia Landfill Closure Group, Centralia, Washington. March 1994a.

CH2M HILL. *Centralia Landfill Remedial Investigation/Feasibility Study/Cleanup Action Plan Draft Remedial Investigation Workplan.* Prepared for the Centralia Landfill Closure Group, Centralia, Washington. July 1994b.

CH2M HILL. *Centralia Landfill Final Cover System Post-Closure Operation and Maintenance Manual.* Prepared for the Centralia Landfill Closure Group, Centralia, Washington. September 1995.

CH2M HILL. *Centralia Landfill, Remedial Investigation Action Plan.* Centralia Landfill Closure Group, Centralia, Washington. January 1996a.

CH2M HHL. *Centralia Landfill Remedial Investigation/Feasibility Study Field Sampling Plan.* Prepared for the Centralia Landfill Closure Group, Centralia, Washington. April 1996b.

CH2M HILL. *Centralia Landfill Remedial Investigation/Feasibility Study Quality Assurance Project Plan.* Prepared for the Centralia Landfill Closure Group, Centralia, Washington. April 1996c.

CH2M HILL. *Centralia Landfill Remedial Investigation/Feasibility Study Action-Specific Safety and Health Plan*. Prepared for the Centralia Landfill Closure Group, Centralia, Washington. April 1996d.

CH2M HILL. *Centralia Landfill Remedial Investigation Report.* Prepared for the Centralia Landfill Closure Group, Centralia, Washington. April 1998a.

CH2M HILL. *Centralia Landfill Feasibility Study Report.* Prepared for the Centralia Landfill Closure Group, Centralia, Washington. April 1998b.

Washington State Department of Ecology (Ecology). *Statistical Guidance for Ecology Site Managers.* August 1992.

Washington State Department of Ecology (Ecology). Statistical Guidance for Ecology Site Managers, Supplement S-6. August 1993.

Table 1
RI Contaminant Concentrations Detected in Surface Water in Weyerhaeuser Ditch

Parameter (units)	Concentrations at Upstream Station SW-9A		Concentrations at Downstream Stations[a]	
	Range of Concentrations	Arithmetic Mean	Range of Concentrations	Arithmetic Mean
Total arsenic (µg/L)	0.55- 0.63	0.58	0.7 - 3.9	1.7
Soluble arsenic (µg/L)	0.49 **S** 0.56	0.52	0.5 **S** 1.7	1.0
Total mercury (µg/L)				
Total manganese (µg/L)	159 - 324	259	90.7 - 10,450	2,319
Soluble manganese (µg/L)	115 - 300	234	64.9 - 10,500	2,217
Total iron (µg/L)	1,200 - 2,280	1,693	1,095 - 22,300	5,716
Soluble iron (µg/L)	424 - 918	666	339 - 1,620	805

[a] Includes downstream monitoring stations SW-10A, SW-11A, and SW-14.

[b] ND = not detected. Method detection limit = 0.1 µg/L.

[c] Total mercury was only detected once in surface water during the RI (at SW-11A).

Table 2
RI Contaminant Concentrations Detected in Shallow Upper/Upper Unit Groundwater

Parameter (units)	Upgradient Concentrations[a]		Downgradient Concentrations[b]	
	Range of Concentrations	Arithmetic Mean	Range of Concentrations	Arithmetic Mean
Conductivity (µmhos/cm)	92 - 281	141	90 - 1,462	530
Chloride (mg/L)	1.09 - 3.92	2.3	1.79 - 269.5	82
Soluble antimony[c] (µg/L)	ND	ND	8.6 - 19.65	12.85
Soluble arsenic (µg/L)	0.12	0.2	1.28 - 32.85	14
Soluble iron (µg/L)	13.3	27	6.5 - 19,900	7,031
Soluble manganese (µg/L)	1 **S** 25.4	12.1	39.6 - 11,300	3,168
Soluble mercury (µg/L)	0.13 - 0.15	0.14	0.11 - 0.3	0.167

[a] Includes upgradient groundwater monitoring stations M-4, MW-1S, and MW-3S.

[b] Includes downgradient groundwater monitoring stations B-1S, B-1SU, B-2S, B-2SU, B-3S, MW-2S, MW-2SU, MW-4S, MW-5S, and MW-CNE1S.

[c] Soluble antimony was detected only at monitoring station MW-CNE1s.

ND = Not detected.

Table 3
RI Contaminant Concentrations Detected in Lower Unit Groundwater

Parameter (units)	Upgradient Concentrations[a]		Downgradient Concentrations[b]	
	Range of Concentrations	Arithmetic Mean	Range of Concentrations	Arithmetic Mean
Lower Unit Groundwater Monitoring Wells				
Soluble arsenic (µg/L)	2.05 - 9.7	6.2	0.25 - 14	3.5
Soluble manganese (µg/L)	106 - 544	348	44.1 - 873	464
Soluble iron (µg/L)	209 - 1,700	955	72.6 **S** 1,870	598
Lower Unit Water Supply Wells[c]				
Total arsenic (µg/L)	NA[d]	NA[d]	0.8 - 11.6	5.2
Soluble arsenic (µg/L)	NA[d]	NA[d]	0.7 **S** 7.7	4.9
Total manganese (µg/L)	NA[d]	NA[d]	284 - 1,140	725
Soluble manganese (µg/L)	NA[d]	NA[d]	281 **S** 1,000	679
Total iron (µg/L)	NA[d]	NA[d]	398 - 18,800	3,312
Soluble iron (µg/L)	NA[d]	NA[d]	255 **S** 6,080	2,088

[a]For groundwater monitoring wells the only upgradient monitoring station is MW-1D.

[b]For groundwater monitoring wells the downgradient monitoring stations include B-1S, B-1SU, B-2SU, MW-2S, MW-2SU, MW-4S, MW-5S, and MW-CNE1S,.

[c]Water supply well stations include 2225 Airport Way NE, 2611 Airport Road, 1217Long Road, 1224 Long Road, and the Mills well at 1220 Woodland Avenue.

[d]NA = not applicable; since the water supply wells are located cross-gradient and downgradient of the landfill, the concentrations of contaminants in water supply wells are grouped together and listed on the "Downgradient Concentrations" columns.

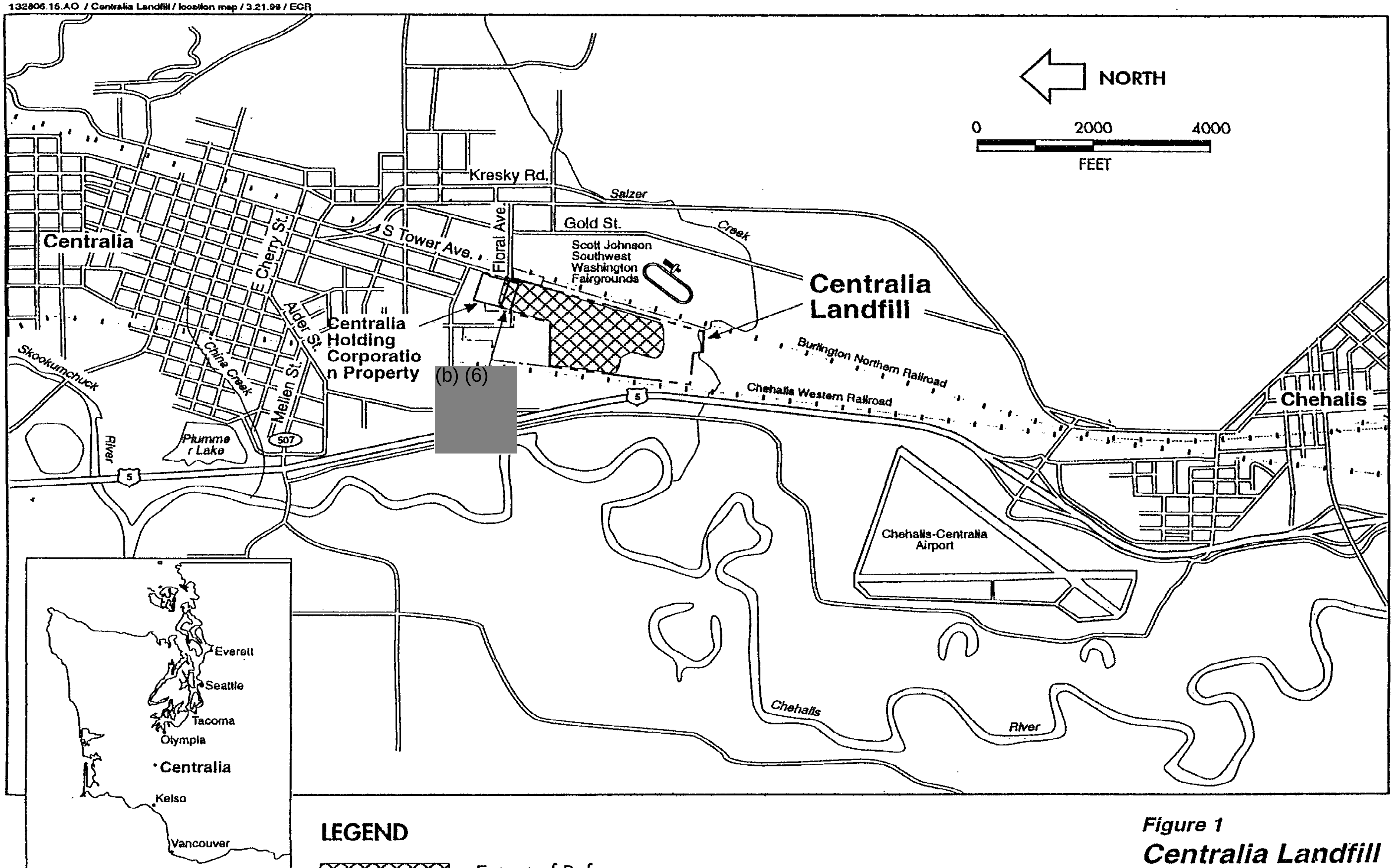
Table 4
Cleanup Levels and Compliance Levels for the Centralia Landfill

Parameter	Cleanup Level	Compliance Level[a]
Surface Water		
Arsenic (soluble)	0.27 µg/L	0.5 µg/L
Shallow Upper/Upper Unit Groundwater		
Conductivity	700 µmhos/cm	NA[b]
Chloride	250 mg/L	NA[b]
Arsenic (soluble)	0.27 µg/L	0.5 µg/L
Iron (soluble)	300 µg/L	NA[b]
Manganese (soluble)	50 µg/L	NA[b]
Lower Unit Groundwater		
Arsenic (soluble)	5 µg/L	NA[b]
Iron (soluble)	300 µg/L	NA[b]
Manganese (soluble)	50 µg/L	NA[b]

[a] This concentration represents the current practical quantitation limit (PQL). Ecology recognizes that in some cases the PQL may be higher than the cleanup standard for a given parameter. In these cases, the cleanup standard may be considered to be attained if the parameter is undetected at the PQL, and the conditions outlined in WAC 173-340-707 are met to Ecology's satisfaction.

[b] NA = not applicable.

132806.15.AO / Centralia Landfill / location map / 3.21.99 / ECR



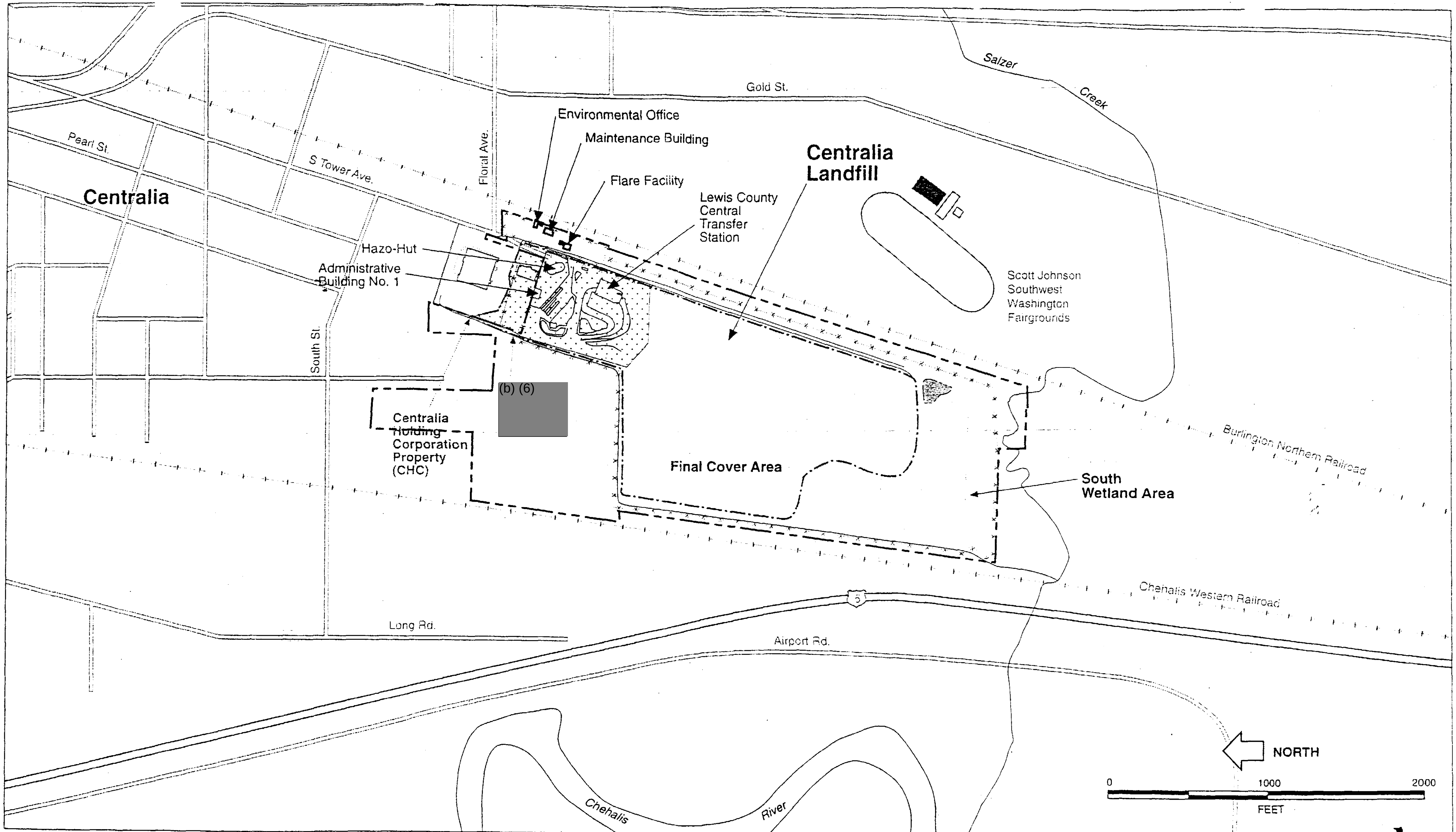
LEGEND

Extent of Refuse

Figure 1

Centralia Landfill Location Map

132806.15 AO / GenSiteFeatAfterSecInt / 3.21.99 /



LEGEND

- Approximate Edge of Refuse and Limits of Source Area
- Fence
- Property Line
- Closed Northend Landfill

Figure 2
General Site Features After the Second Interim Action

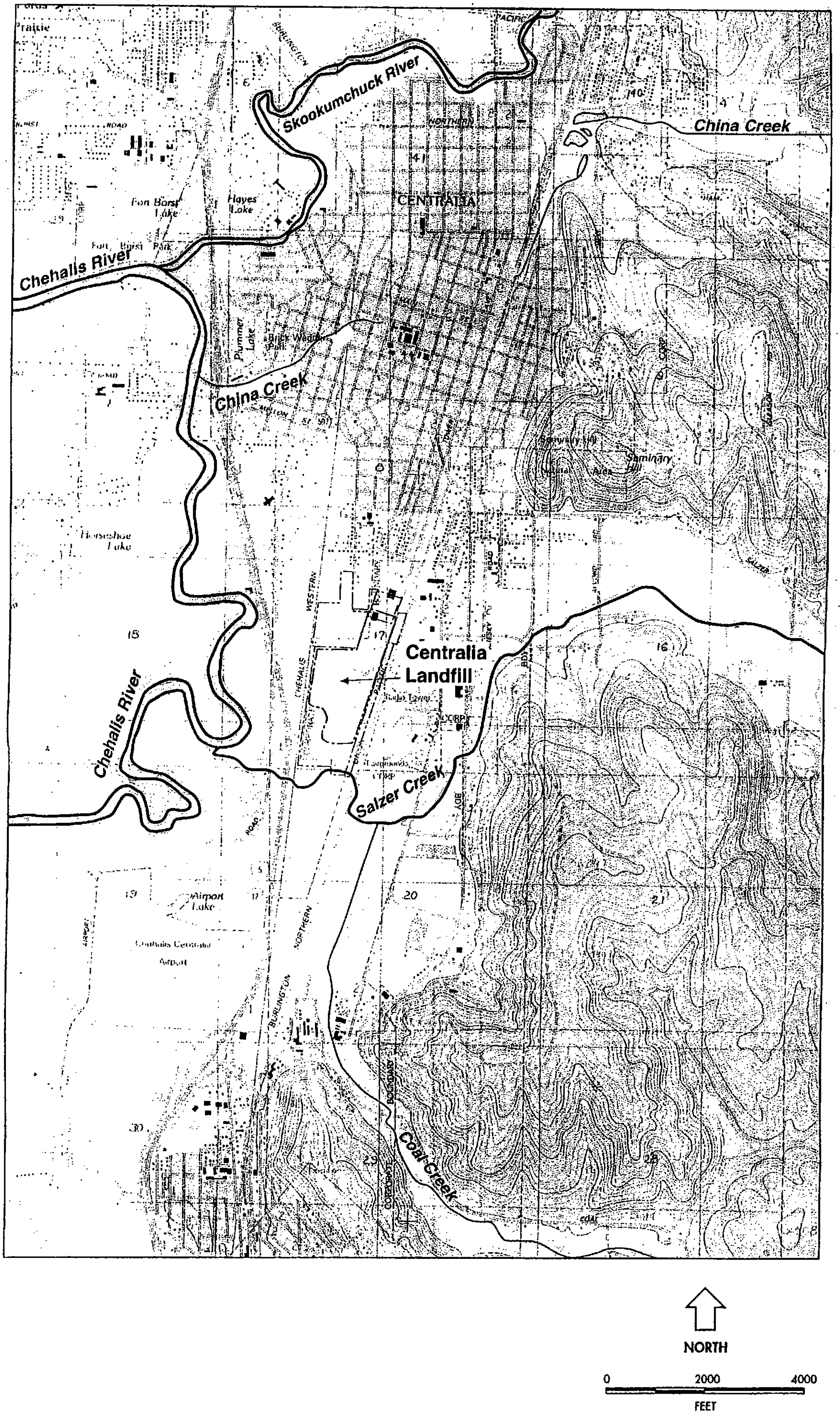
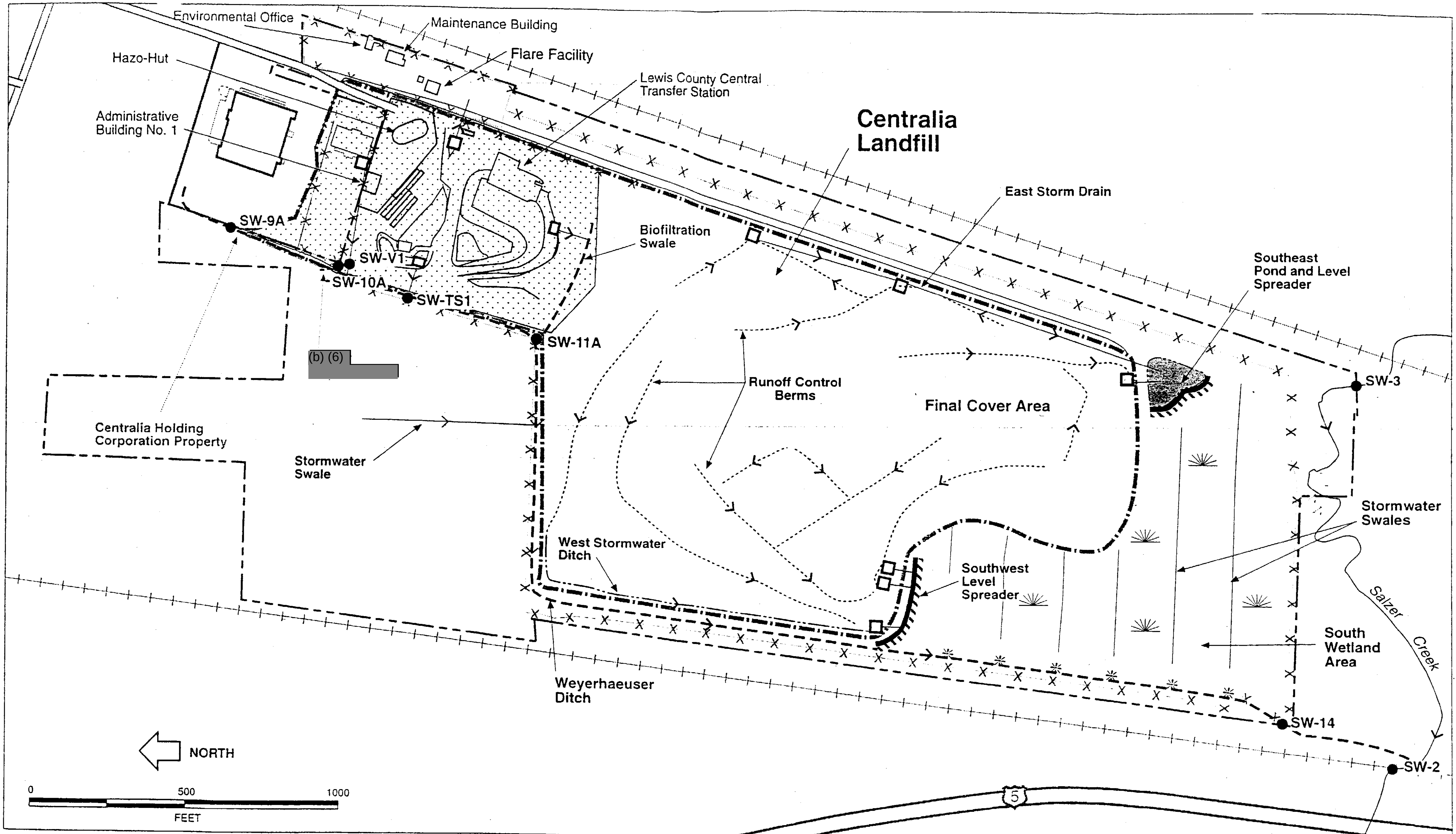


Figure 3
Regional Surface Water Features

132806.31.ZZ / New GrwtrMonWell base / siteSpec   tFeat / 4.12.98 / ECR



LEGEND

- Approximate Edge of Refuse
- Fence
- Grassy Wetland Area
- Stormwater Level Spreader
- Runoff Control Berm
- Stormwater Catch Basin/Inlet
- Culverts with Slide Gates
- Closed Northend Landfill
- RI Surface Water Monitoring Station

Figure 4
Site-Specific Surface Water Features

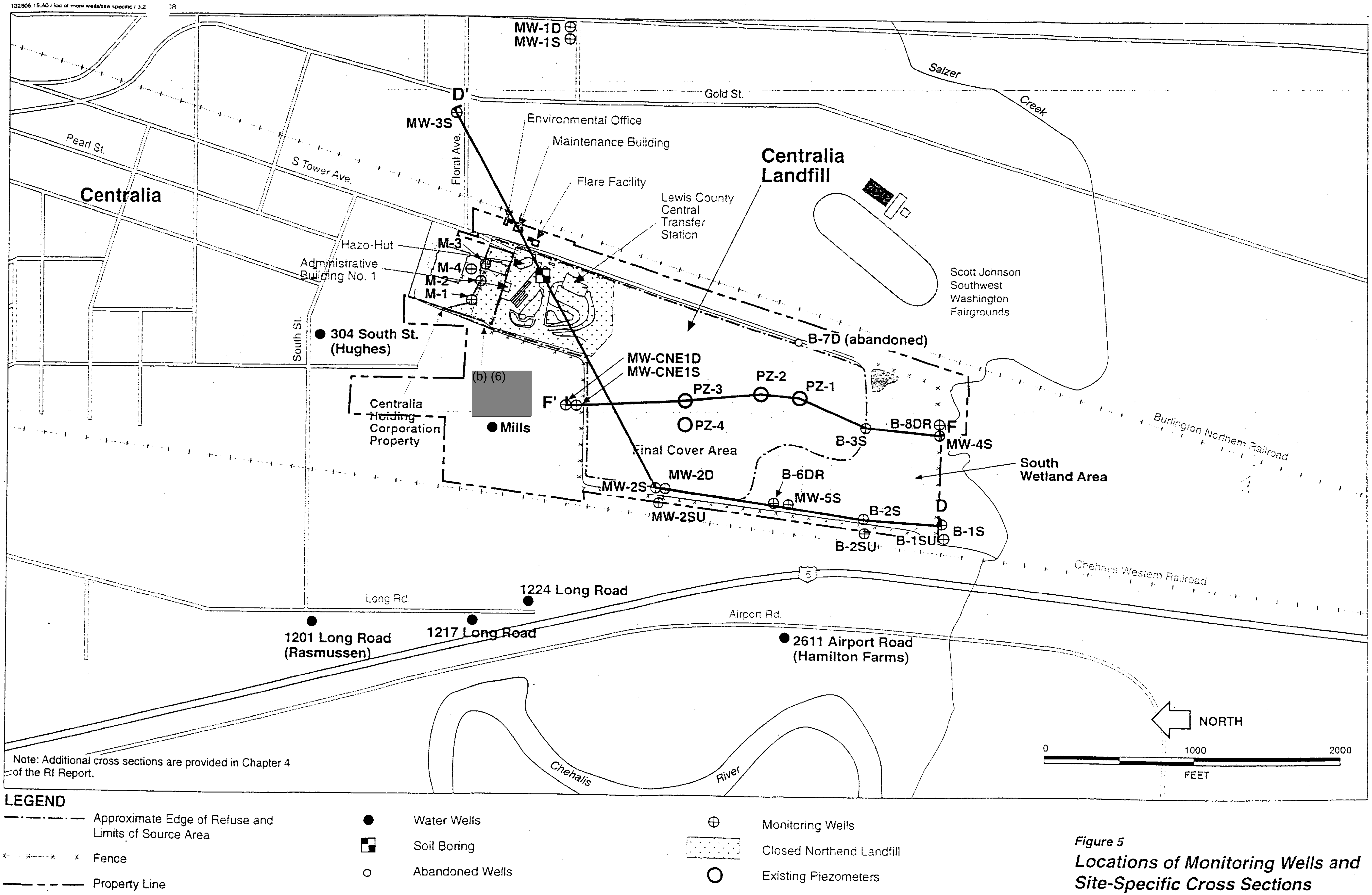
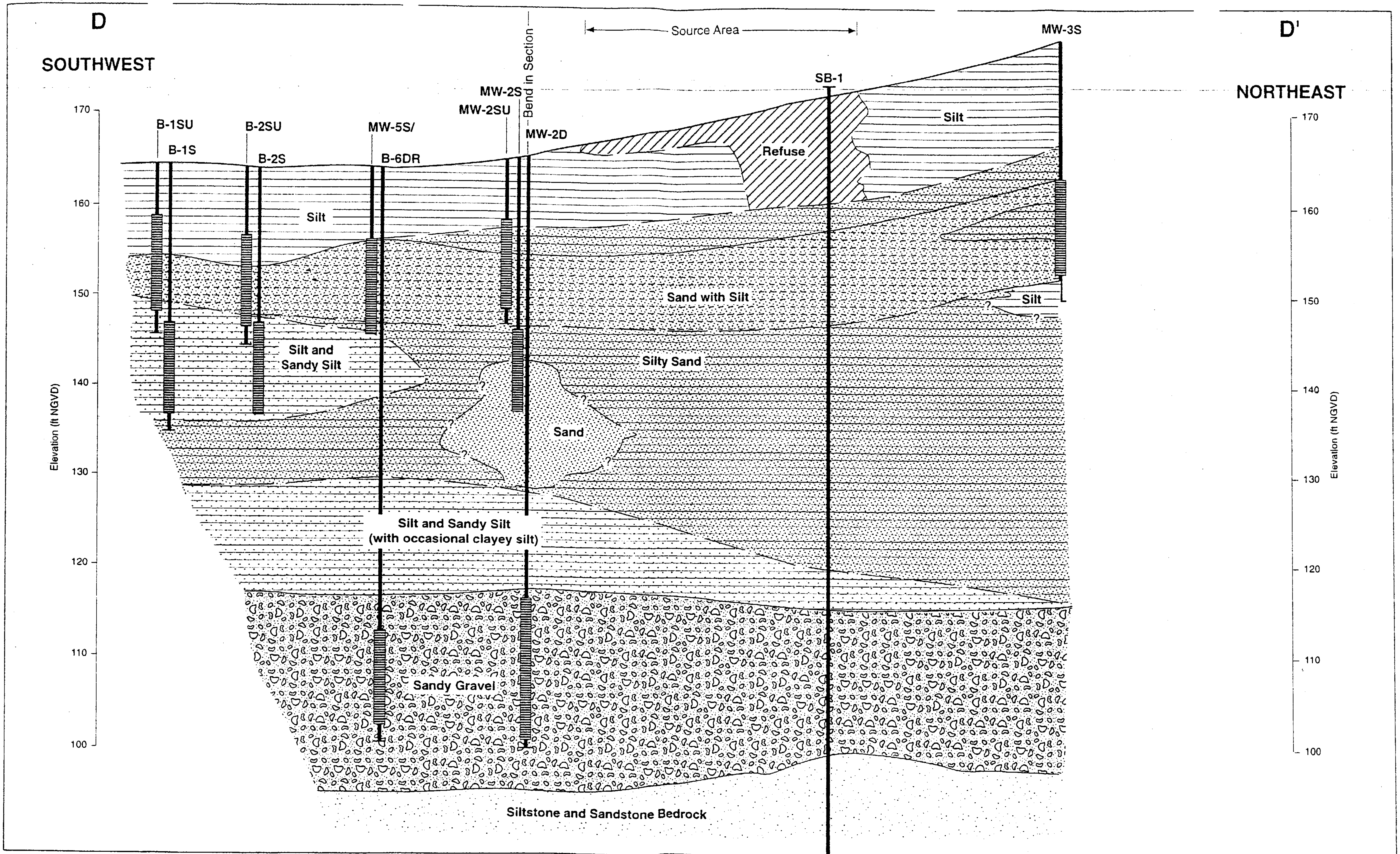


Figure 5

Locations of Monitoring Wells and Site-Specific Cross Sections

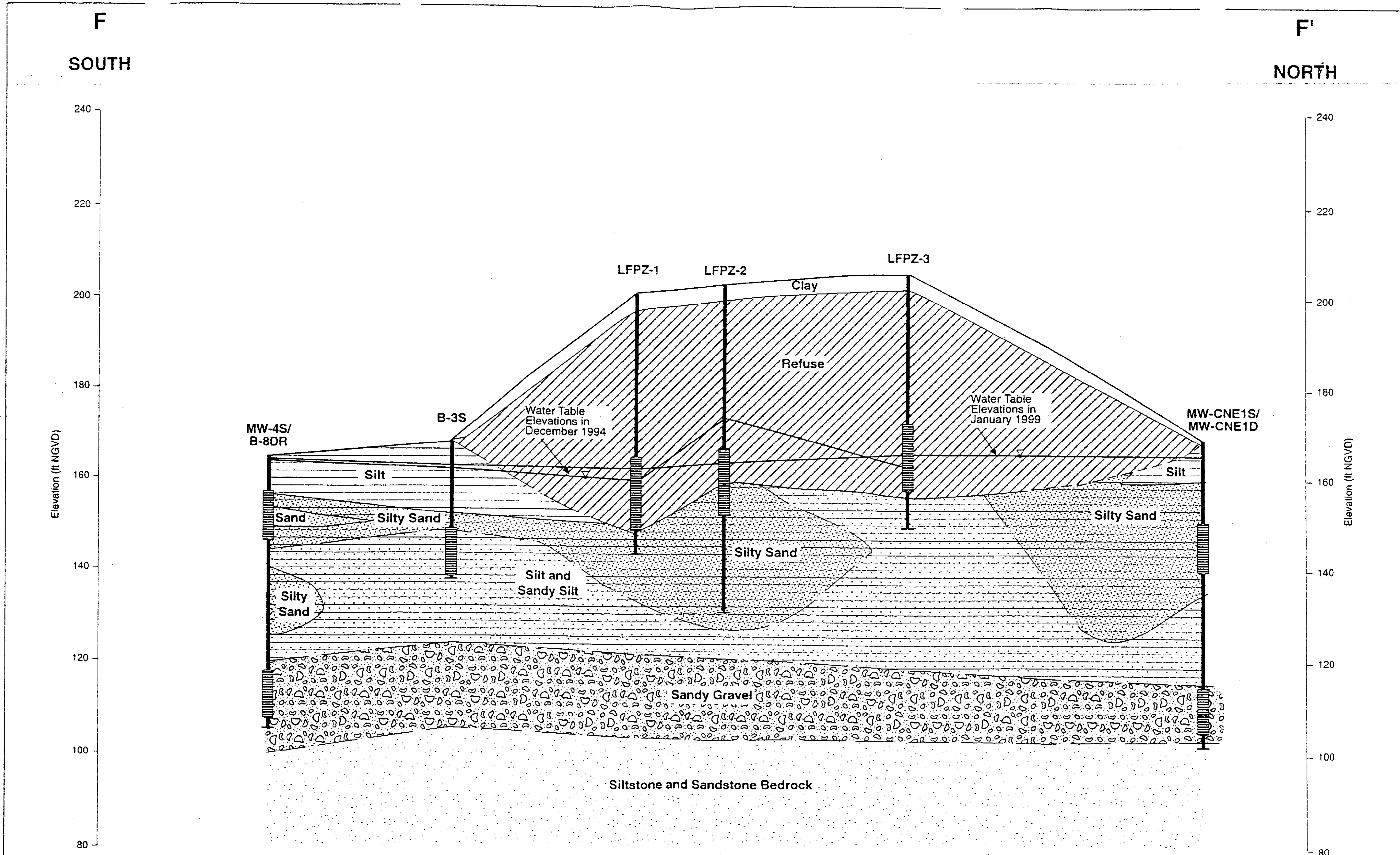


LEGEND

- Sand with silt to trace silt
- Sandy gravel
- Silty sand
- Silt
- Silt and sandy silt
- Bedrock
- Refuse
- Sand
- Inferred contact

0 500 1000
FEET
Vertical Exaggeration: 50X

Figure 6
Geologic Cross Section D-D'

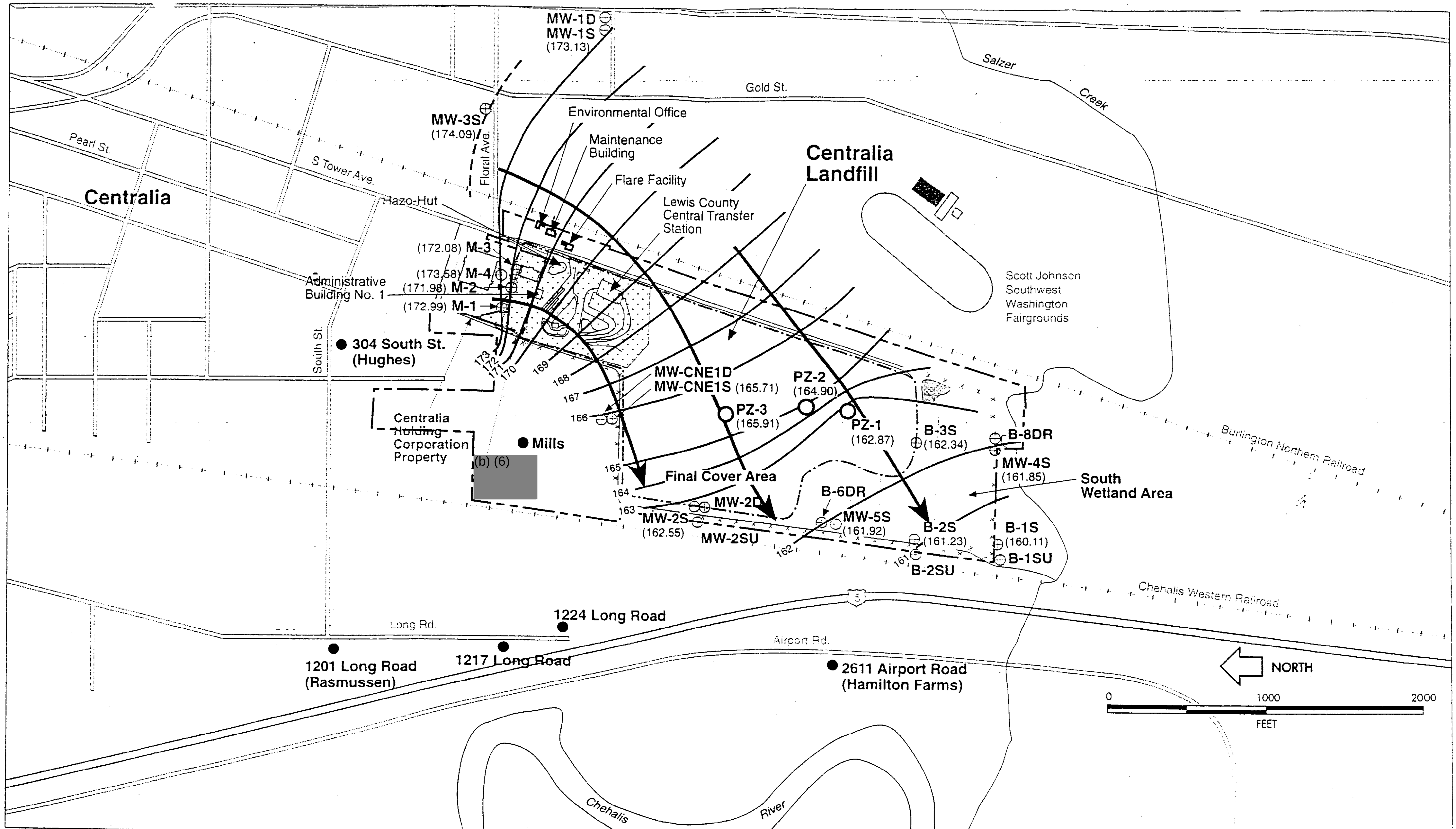


LEGEND

Sand with silt to trace silt	Silt	Refuse	Inferred contact
Sandy gravel	Silt and sandy silt	Sand	
Silty sand	Bedrock		

0 250 500
FEET
Vertical Exaggeration: 12.5X

Figure 7
Geologic Cross Section F-F'

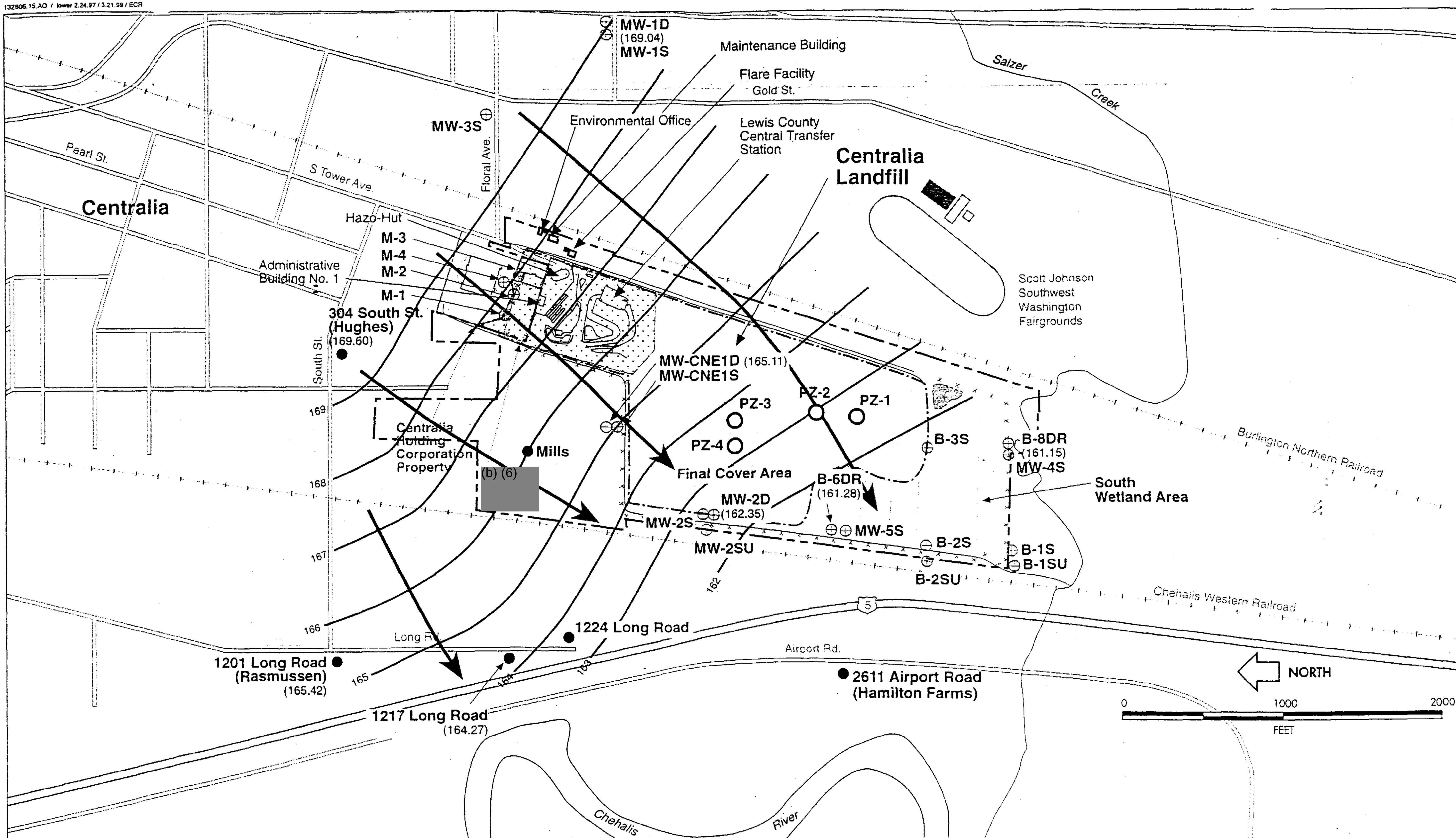


LEGEND

- Approximate Edge of Refuse and Limits of Source Area
- Fence
- Property Line
- Water Wells
- Groundwater Flow Direction
- Monitoring Wells
- Closed Northend Landfill
- Existing Piezometers
- Groundwater Elevation Contour

Figure 8
Upper Unit Groundwater Elevation Contour Map
February 24, 1997

132806.15.AO / lower 2.24.97 / 3.21.99 / ECR



LEGEND

Approximate Edge of Refuse and Limits of Source Area

Fence

Property Line

Water Wells

Groundwater Flow Direction

Monitoring Wells

Closed Northend Landfill

Existing Piezometers

Groundwater Elevation Contour

Figure 9
Lower Unit Groundwater Elevation Contour Map
February 24, 1997